NPIC/TDS 0224 B-Sec Act

Post Office Box 6788
Fort Davis Station
Washington, D. C. 20020

REGISTERED

10 MAR 1967

(See attached list for names of solicited bidders)

Attention:

Subject : Request for Proposal No. RD-13-67
Project No. 02227

Gentlemen:

This office has a requirement for the design and fabrication of a prototype Twin Stage Comparator. Your review of the enclosed "DEVELOPMENT OBJECTIVES - Twin Stage Comparator" is requested and a technical proposal and cost and price quotation on this program is solicited.

Prior to the submission of your proposal if a conference is desired between your technical representatives and the technical representatives of the Government you may arrange for such a conference
25X1 by contacting [redacted]

Your technical proposal and cost quotation should be submitted no later than 10 April 1967 unless a later date is requested of and
25X1 authorized by [redacted] It is requested that your proposal be accompanied by a cost analysis breakdown to assist in evaluating your quotation. This cost breakdown may be prepared on Form DD-633 or a substantially similar form. Two copies of the proposal should be forwarded directly to the Contracting Officer. Three copies should be forwarded to the Technical Representative of the Contracting Officer at the following address:

25X1 [redacted]
Post Office Box 8031
Southwest Station
Washington, D. C. 20024

The enclosed development objectives may be considered DE-CLASSIFIED when removed from this covering letter which may NOT be de-classified. Government interest may be shown, however, association of this Govern-

Subject: Request for Proposal No. RD-13-67
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ment activity with this request is classified CONFIDENTIAL. In this connection, knowledge of the identity of the particular Government activity which the undersigned represents must be restricted to the least number of persons possible and then only to those who have been authorized in writing by this activity to have access to classified information. Such identity whall be disclosed only on a verbal basis and shall never appear in writing in any of your documents. Any correspondence initiated by you should not make reference therein to the undersigned. "Secrecy Agreements" should be signed by any individual in your company who will have knowledge of this request.

If it is desired to proceed with this contemplated program with your company, the authorization will be effected by the issuance of the appropriate type of Government Contract.

At the time of submitting the requested proposal(s) please return this letter, together with all enclosures, to the undersigned at the address stipulated above, Attention: [redacted] If you do not elect to submit a proposal, this letter and all correspondence should also be returned. 25X1

Very truly yours,

[redacted] 25X1
Contracting Officer

Enclosures:

Development Objectives
with attachments (2 copies)

Distribution:
Original - Addressee
1 - PD File
1 - NPIC/Req. Office
1 - NPIC/TDS
1 - NPIC/Chrono

25X1 **LB/SS/NPIC:** [redacted] **(8 Mar 67)**

Next 1 Page(s) In Document Exempt

Approved For Release 2005/05/02 : CIA-RDP78B04770A001200010014-4

17 February 1967

DEVELOPMENT OBJECTIVES

Twin Stage Comparator

1. INTRODUCTION

These development objectives describe the requirements to be met in the design and fabrication of an operational prototype Twin Stage Comparator.

2. CONCEPT

This project is to develop an instrument to provide the photo interpreter with a capability for obtaining precise measurements as part of routine photo interpretation.

The Twin Stage Comparator is intended to bridge the gap between the high-precision mensuration tools currently available to the photogrammetrist and the cruder instruments normally used by the photo interpreter. In designing this instrument, emphasis is to be placed on ease of operation, reliability, simplicity, measuring accuracy, and reproducing production quantities of 10 or more at a reasonable price.

3. GENERAL DESCRIPTION

This shall be a compact light weight device incorporating a high performance stereo viewing system, twin scanning stages, and a measuring engine with two-axis digitizers. The Government is presently using a stereo viewing system that meets the requirements of this project. The viewing system is covered in Par. 4.1.

The two photo stages shall be supported on separate X-Y carriages and have a free aperture of 5 by 5 inches. A differential drive shall be provided between the two photo stages to permit stereo scanning of film chips of two different scales.

The movements of the X-Y carriages of one photo stage shall be measured by two digitizers (X & Y) with a measuring range of 5 inches in both the X and Y directions. The signals from the X and Y digitizers shall be processed and converted into a format acceptable for on-line computer use.

4. DETAILED REQUIREMENTS

4.1 Viewing System

The Government has in use a redesign of the [redacted] High Power Stereoviewer. This viewer has a reticle located in an intermediate image plane of one of the optical paths and it is being successfully employed as part of an ultra precise mensuration system. 25X1

The Technical specifications for this Stereoviewer are attached to this Development Objective.

The focusing mechanism is not provided as part of the viewing system. The contractor will have to design the instrument focusing system. This may be accomplished by moving the individual film stages in the Z direction (up and down) or by raising and lowering the optical system. Both a coarse and a fine instrument focus shall be provided; the gear ratios of these focus motions must be appropriate to the magnification ranges involved.

The Contractor is encouraged to use this optical viewing system as part of the comparator. If he prefers a substitute system, two alternate bids shall be submitted, one based on the B&L system and the other on the substitute system.

4.2 Film Stage and Hold-down System

4.2.1. There shall be two film stages, each capable of handling film chips in sizes up to 5 inches by 5 inches.

4.2.2. Each of the film stages shall be supported on separate X-Y carriage assemblies.

4.2.3. Each of the film stages shall have independent translation of ± 5 inches in both the X and Y axes. The optical viewing system and the illumination source shall remain stationary (in X and Y).

4.2.4. The measuring stage will provide a mechanical rotation of ± 10° and the non-measuring shall have 360° rotation capability.

4.2.5. A design shall be a variable differential drive between the two film stages to permit the scanning of two different scale images in stereo. The X and Y motions of both stages shall be remotely controlled from the operator's console.

Provision must be made for both independent and common stage-drive speeds varying from .001 inch per second to 1 inch per second.

4.2.6. Film hold-down may be accomplished through glass pressure plates or other mechanical means, but it must be capable of maintaining film in sharp focus over the entire format.

4.3. Film Measurement System

4.3.1. Only one of the two film stages shall have a measuring capability. This measuring stage shall have two-axis (X and Y) digitizers with a measuring range of ± 5 inches in both axes.

4.3.2. The prime objective of this system is to produce the highest possible accuracy over short distances (up to 1 inch) with less emphasis on accuracy over longer distances.

A design goal shall be 2-micron accuracy for measurements of 1 inch or under. An accuracy of at least 1 part in 5,000 shall be provided over the entire film format.

4.3.3. Repeatability of measurements is of major importance.

4.3.4. The least count or pulse increment shall be 1 micron.

4.4. Measurement Readout System

The Twin Stage Comparator is intended for on-line computer use: 1) At the customer's facility utilizing a UNIVAC 494 as the central computer and; 2) At a decentralized location as a self-contained system incorporating its own small on-line computer.

4.4.1. Twin Stage Comparator on-line to a central computer (UNIVAC 494).

4.4.1.1. Since most of the customers in-house on-line systems utilize [redacted] components, the vendor is requested to use compatible (not necessarily [redacted] equipment. Attachment 4 provides the specifications for the data acquisition system.

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4.4.1.2. The Contractor will provide and fabricate: (1) a control panel ([redacted]2825A or equivalent) with integral visual display; (2) movable cabinet (on casters) containing the necessary electronic decoders, synchronizers, buffers, special character generators, etc. to process and convert the data from the two-axis encoders and from the control panel into a signal which will be accepted by the central computer utilizing existing programs.

4.4.2. Twin Stage Comparator on-line to a small computer. A self contained system for use at a decentralized location.

4.4.2.1. The contractor shall furnish a complete self-contained mensuration system that can be readily transported and used in decentralized locations.

4.4.2.2. An integral pre-programmed computer shall be furnished by the contractor. The contractor shall furnish the programs necessary to handle the following photography: Frame (vertical and oblique), Pancramic (vertical and oblique), and Strip (vertical and oblique).

4.4.2.3. Programs shall be loaded into the computer from an auxiliary tape/typewriter Input/Output unit. The computer need not have a storage capacity that can hold frame, panoramic, and strip programs simultaneously. Each program can be loaded individually for use on a specific camera format.

4.4.2.4. The camera and operational parameters shall also be entered from the keyboard or tape reader.

4.4.2.5. On command by the operator, the X and Y coordinate information from the comparator shall be read into the computer.

4.4.2.6. The rectified ground distances shall be printed out as a hard copy on the typewriter and/or punched out on paper tape by the Input/Output unit.

4.4.2.7. The X and Y coordinates of the measuring stage shall be displayed on in-line Nixie tubes (six decades plus sign per axis). Pre-set and reset capability shall be provided.

This numerical display shall be metric with a least count of one micron.

4.4.2.8. The typical operating procedure for an operator on this self contained system might be: (1) Operator loads frame program and required subroutines into the computer; (2) Film chips are properly aligned on film stages. Stages moved and recticle positioned over a fiducial or reference mark on film chip that is on the measuring stage. Coordinate values are reset or preset as required; (3) Computer program is initiated. As computer calls for photo parameters (focal length, pitch, roll, yaw, flying height, etc.) they are entered by the operator from the keyboard or paper tape; (4) Operator locates the photo area in stereo and uses the reticle to point to a corner of a building. X and Y coordinates are indicated on visual Nixie tube display; (5) Operator sees light indicating computer is ready. Operator presses button and the coordinates are entered in the computer; (6) Operator uses joystick to move another corner into view, places reticle on corner, and presses "Enter" button again; (7) Operator presses "Compute" button and rectified ground distance is printed out and/or punched on paper tape.

4.4.3. The contractor is requested to submit his bid in three parts: (1) Bid to design and fabricate a Twin Stage Comparator to be used on line to a central UNIVAC 494 Computer. (2) Bid to design and fabricate a self-contained system for decentralized use. A Twin Stage Comparator with a small on-line computer and auxiliary equipment to function as an integrated system. (3) Bid on both methods combined. A Twin Stage Comparator with small computer and auxiliary equipment for use as: 1) an integrated system at a decentralized location and 2) use on line to a UNIVAC 494 at a site employing a central computer.

4.5. Stage Illumination

4.5.1. General. A high-intensity optimized condenser type light source shall be provided beneath the surface glass plate of each chip stage. This source shall be designed for and mated with the microscope to insure maximum total performance from the optical viewing system.

4.5.2. Intensity Range. At full intensity, the high-intensity sources must provide adequate illumination of a film area with an average density of 2.5 units as viewed through the optical system at both eye stations while operating at a magnification of 200X. All other magnification settings shall be equally well illuminated. These sources shall operate at a color temperature between 3500° - 5500°K.

4.5.3. Variability of Intensity. Means shall be provided for continuously varying the illumination from 50% to 100% of full intensity on each independent high-intensity source without reducing the color temperature below 3500° K.

4.5.4. Control of Intensity. Separate controls for varying the intensity of illumination of each separate illumination source shall be provided.

4.5.5. Heat. The temperature on the surface of each stage plate shall not exceed 100°F after operating at maximum intensity over a 24-hour period in an 80°F ambient temperature while a neutral density of 1.5 covers the plate. Necessary care shall be taken to assure that the film is adequately cooled so as to prevent dimensional changes which could affect mensuration reliability.

4.5.6. Overall Illumination. A second, overall lighting system shall be provided to illuminate the entire format for general viewing and pre-selection of points to be measured.

4.6. Control Console

4.6.1. General. The complete system shall be designed in accordance with correct ergonomic principles for easy, comfortable, rapid operation.

4.6.2. Controls shall be provided for setting a variable differential drive to couple the corresponding axes of the second (non-measuring) stage to those of the measuring stage.

4.6.3. Controls shall permit independent translation of either stage or common translation of both stages with a single "joystick."

4.6.4. The stage drive controls for both slewing and fine positioning shall be smooth and positive.

4.6.5. Variable speed drive controls to cover the range of .001 inch per second to 1 inch per second must be provided.

4.6.6. See Attachment 4 for numerical display and input panel.

4.7. Overall Physical Considerations

4.7.1. The size of this comparator is to be kept at a very minimum. The length and width shall be no greater than 48 inches by 34 inches.

4.7.2. The comparator shall have its own stand or mounting and shall be provided with suitable casters for moving. Leveling pads or mounts, that can be easily and quickly activated, shall be provided.

4.7.3. This instrument shall be designed to operate in a normal PI work area. The environmental conditions in this work area will normally be held to temperatures of 72°F ± 5° and relative humidities of 55% (+ 15% to - 5%).

4.7.4. Shielding shall be provided throughout the system so that no circuits are adversely affected by RFI.

4.8. Reliability and Service Time

4.8.1. The comparator and related equipment shall be designed to withstand service usage, under normal operating conditions, for a period of 500 hours (5 hours per day operation) without significant degradation of performance, and with only minor maintenance due to normal expendable replacement parts.

4.8.2. Reliability and maintainability shall be a major factor in the planning, design, and engineering of this instrument.

4.8.3. The design shall permit: 1) ease of assembly and disassembly, 2) ready access to potential trouble sources, 3) maintenance with tools and equipment normally available to maintenance personnel, and 4) external test points.

5. MISCELLANEOUS

5.1. Although there are certain very high performance requirements for this instrument, it should be emphasized that many areas of potential automation are omitted so that the requirements may be satisfied with a minimum of complexity, size, and cost. If there are devices or subsystems

which are not specifically listed as requirements, but which might significantly contribute to the usefulness or ease of operation, they may be included at the vendor's discretion as optional features in the proposal. However, each optional feature must be individually priced.

5.2. At the time of delivery of the equipment, the contractor shall also provide the following: 1) Operators Instruction Manual; 2) Maintenance Manual (including schematics); 3) Recommended spare parts list, including the cost of each item and the total parts package cost.

5.3. Electric Hazard. The unit must be grounded and free of all electric shock hazards.

5.4. Warning Light.

A warning light must be provided to show when the power supply to the system is switched on.

5.5. Controls.

All controls must be properly marked, conveniently located, and readily accessible to the operator.

5.6. Alarms.

Limit switches shall be located at the extremes of travel of the X and Y carriages of both film stages to prevent damage to the system.

5.7. Reporting.

The contractor shall agree to comply with reporting procedures as stated in specification No. DB-1001.

5.8. Interface.

The contractor shall be responsible for all electronic interfacing, logic circuitry, and cabling between the digitizers, encoders, digital display, and on-line computer.

6. CONTRACTOR'S PROPOSAL

6.1. The contractor's proposal must include answers to the following questions:

6.1.1. Is it theoretically feasible to develop the comparator as described in these Development Objectives?

6.1.2. Is it practical to fabricate such an instrument? This analysis must include an economic analysis of the various features required, an examination of the practical compromises, and a comparison of the cost of the advanced features (both prototype and production models) as related to the value of increasing the various levels of instrument performance above that of existing equipment. Alternates and their relative costs shall be included.

6.1.3. What problems are anticipated in the manufacture of the instrument? This analysis must include the anticipated cost of various production quantities (up to 20), as well as an estimate of the prototype development and fabrication cost.

6.2. Artist Concept.

An artist concept of the system shall be included in the proposal. It shall be no larger than $8\frac{1}{2}$ by 11 inches.

6.3. Production Cost.

The proposal shall include an estimate of production costs of the instrument in quantities of 5, 10, 15, and 20. Desirable options may be included if the contractor wishes; however, they must be priced both jointly and separately.

Attachments:

1. Specification No. DB-1001
2. Tech Specs on [redacted] Stereoviewer
3. Tech Specs for Optics if [redacted] Stereoviewer is not used.
4. Data Format

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25X1

Attachment 2

TECHNICAL DESCRIPTION FOR [redacted] HIGH POWER STEREO COMPARATOR HEAD 25X1

This instrument is to be used as the optical viewing subsystem of a photographic measuring instrument. It is a major redesign of the High Power Stereoviewers manufactured on previous contracts with the U.S. Government. The primary change is in the optical system, to enable the reticles to be placed in an intermediate image plane, rather than in the eyepieces where they can be displaced when adjusting the inter-pupillary distance (IPD). Mechanical changes are required to accommodate the optical changes. In addition, the eyepiece angle will be adjustable.

The instrument consists of two [redacted] Dynazoom Laboratory Microscopes coupled with an optical system to form a stereoviewer. The DynaZoom pod has a continuously variable magnification from 1X to 2X. A magnification range from 7.8X to 200X is covered with 6X and 10X [redacted] Compensating Widefield eyepieces and 1.3X, 3.0X, 6X, and 10X objectives. The 3.0 and 6X objectives are not both needed to cover the magnification range, but the 3.0X objective gives a wider field and the 6X objective gives higher resolution. 25X1 25X1

Each optical system consists of an objective, the zoom elements, a penta prism to direct the path horizontally, an image rotation prism (Pechan), reticle, a field lens, a mirror to incline the path toward the eyepieces, a 1X relay lens, a field lens, and the eyepiece.

The following objectives are to be used with this instrument:

Catalog #	Magnification	Focal Length	Numerical Aperture
[redacted] Special Order	1.3X		
[redacted] Fluotar (5100)	3.0X	26.3 mm	0.10
Fluotar (5105)	6X	21.0 mm	0.20
Fluotar (5050)	10X	15.0 mm	0.45

25X1 25X1

The objective lenses are mounted in a four-position centerable nose-piece. The [redacted] 3X, 6X and 10X objectives are parfocal and require very little refocusing when changing objectives. 25X1

The 1.3X [redacted] objective is a special, wide field lens designed primarily to help locate the object to be measured. It is not designed for the [redacted] eyepieces, but works well with it. 25X1 25X1

The zoom is adjusted by means of a knob on the top of each pod. It is graduated from 1X to 2X in tenths.

The housing above the zoom system has been redesigned and, due to the complexity of the penta prism mount, the ability to provide monocular viewing or photomicrography has been omitted.

The Pechan prism rotates the image continuously without limit. An 180° rotation of the prism rotates the image 360°. The prism mount has a knurled knob for turning and numbers to indicate approximately the amount of image rotation.

The reticle is mounted in a two-position slide, so that the reticle will consist of an engraved and filled black dot, 0.016 $\pm$ .004mm, in the center of the field.

The IPD of the eyepieces is adjustable by means of a lever through a range of 55 to 72mm. The eyepieces are nominally 30° to the horizontal and are adjustable $\pm$ $7\text{-}\frac{1}{2}^{\circ}$ for operator convenience.

Adjustment of the eyepiece angle causes image rotation. A graduated scale reads the eyepiece angle. This angle must be transferred to a slip ring to set the "Zero" index for the Pechan prism which automatically compensates for the image rotation due to changing the eyepiece angle.

The centers of the objectives will be nominally 12.102 inches apart.

During the course of a measurement sequence, the Zoom knob and the image rotation prism must not be rotated. The nosepiece must not be rotated nor the centering adjustment moved.

The following eyepieces are to be used:

Catalog #	Magnification
25X1 [redacted] Compensating (5551)	6X
Compensating (5583)	10X

Resolution, field of view, etc. depend on the combination of eyepiece and objectives used and the position of the zoom system. The following table gives the nominal field size for combinations of the above listed eyepieces and objectives when the zoom is at 1X. When the zoom is at a position other than 1X, the total magnification is multiplied by the zoom magnification, and the field is divided by the zoom magnification.

Eyepiece	Objective	Magnification	Field
6	1.3	7.8	14.0mm
6	3.0	18	6.0mm
10	1.3	13	14.0mm
6	6	36	3.0mm
10	3.0	30	6.0mm
6	10	60	1.8mm
10	6	60	3.0mm
10	10	100	1.8mm

25X1 With the 10X [redacted] eyepieces, the zoom at 2X and the 10X [redacted] 25X1
Fluotar objective, the instrument will have a maximum axial resolution of approximately 1200 lines per mm.

[redacted] 25X1

Attachment 3

25X1

TECHNICAL SPECIFICATIONS FOR THE OPTICAL SYSTEM IF THE [redacted] STEREOVIEWER IS NOT USED

1. Magnification. Magnification shall be continuously variable from 7X through 200X. This may be accomplished by the use of a high-resolution, zoom-type system and exchangeable objective elements (turret-mounted). If exchangeable objectives are used, the ranges of the magnification shall have an overlap of at least 10% at each stage and the objectives shall be parfocal.

2. Resolution. The on-axis resolution of the entire system, including anamorphic magnification, must be at least 8 line-pairs/mm per magnification power at a magnification of 7X, decreasing linearly to no less than 6 line-pairs/mm per magnification power at 200X. The zoom system shall not depart from linearity by more than 2%, and the resolution over the entire field of view at any specific magnification shall not decrease by more than 20% from that exhibited on-axis.

3. Image Quality. Image quality available to the operator should, at all magnifications, approximate that of a very high-performance microscope with respect to: aberration corrections, field size, field flatness, numerical aperture, visual acuity, contrast, and resolution; e.g., image quality at least equivalent to that exhibited by the [redacted] High-Power Stereoviewer--equipped with the 3X (N.A. = .10), 6X (N.A. = .20), and 10X (N.A. = .45) [redacted] Fluotar objectives used in conjunction with their 6X and 10X Compensating Widefield High Eyepoint eyepieces--should be provided.

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25X1

4. Field of View. Both the real and the apparent fields of view shall approximate that of high performance microscope design at all powers. Viewing will be by binocular eyepieces--an angular field of 35° or better is a design goal.

5. Independent Zoom. The optical image paths must provide both independent and common zoom magnification.

6. Image Rotation. Optical image rotation of 360° shall be provided for each optical path. This shall not introduce distortion or displacement with respect to the reticle.

7. Anamorphic Correction. Each eyepath shall incorporate anamorphic correction with a continuously variable ratio from 1:1 to 1:2.2. The direction of anamorphic magnification must be rotatable through 360°. It is highly desirable that this element or optical path be separate so that it is capable of being in or out of the system at the viewer's option so as to not impose a constant restraint upon the overall optical quality of the system in these situations when anamorphic correction is not required.

8. Focus. Independent focus shall be provided for each optical axis, and means shall be provided for adjusting the differences in focus between the right and left eyes of the operator. Both a coarse and fine instrument focus shall be provided. The gear ratios of these focus motions must be appropriate to the magnification ranges involved.

9. Interpupillary Distance Adjustment. An adjustment for variation in interpupillary distances of between 52mm and 80mm shall be provided, together with an easily readable graduated scale to indicate actual millimeter settings. This adjustment must be provided with a positive lock.

10. Eyepiece Positioning. The eyepiece unit shall be inclined up, toward the operator at an angle of 30° measured up from the horizontal and shall be adjustable over a range of $\pm 15^{\circ}$. A positive lock must be provided for this adjustment so that once a comfortable position is achieved it can be retained.

11. Eyepoint. The optical system must be designed to accommodate viewing by operators both with and without eyeglasses.

12. Eyeshields. Separate pairs of eyeshields for the eyepieces shall be provided for use by persons with and without eyeglasses.

13. Objective Design. Computation and design of the matched objective elements shall take into account a satisfactory but safe working distance from the glass pressure plate, large field of view, and visual fidelity of the highest order. Allowance for the glass of the pressure plate shall be incorporated into the design of the objective lenses.

14. Depth of Field. Maximum depth of focus, while still maintaining a flat field and adequate aberration corrections, is of special importance, since images on photographic films with a thickness tolerance of $\pm$ 0.15 mil. will be the prime input to this system. A capability shall be provided to focus the high power objective elements for viewing film emulsion up or down for film bases ranging in thickness from 2 to 7 mil.

15. It is a design goal that an optical switching system be provided to permit binocular monoscopic viewing of either the right or left stage (whichever one is the measuring stage) in place of the normal stereoscopic viewing of both stages concurrently.

16. Reticle. The reticle shall be introduced as close to the objective lens as possible to avoid problems of parallax. It shall be a circular dot with a clearly defined edge. The size of the reticle dot shall be variable with magnification from one-half minute to four minutes of arc.

Attachment 4

DATA ACQUISITION SPECIFICATIONS

1. Input Devices.

The input devices shall consist of the two-axis encoders and a control panel. The control panel shall enable the operator to pre-set the counters and to feed auxiliary information to the computer through various switches. The control panel shall also provide a visual digital display of the relative X and Y coordinate positions.

1.1 Encoders. The type of system shall be selected by the contractor.

1.2 Control Panel. The control panel shall be a [redacted] 25X1

25X1 [redacted] control panel model 2825A or equivalent.

2. Signal Processing Device.

The signal processing device shall provide a direct communication link between the coordinate measuring equipment and a central computer on a real time basis. Transmission between the computer and the remote station is to be via two PWC S4193 cables or equivalent (One wire in the cable is for send, one wire is for receive, and one or two wires are for ground) this cable will be provided. (Steps have been taken to reduce interference from outside sources). One transmission cable, initiating at the central computer site, is to be connected to a Teletype Model KSR35 page printer. The contractor, however, is to have no responsibility for the Teletype except for consideration of placement and possible electromagnetic interference from it. The second cable from the computer is to be connected to the signal processing device. There will be no data connection between the teletype and the signal processing device except through the computer link.

2.1. Transmission Interface.

2.1.1 Transmission is asynchronous with the rate of transmission to be fixed at 1200 bits per second ± 1% tolerance, and is binary serial.

2.1.2 A negative voltage (optimum -10 volts) represent-off or marking (1), a positive voltage (optimum +10 volts) represents on or spacing (0). The signals should have a high impedence.

2.1.3 In addition to the information bits to be transmitted, two pulsing bits must be transmitted for each character.

A start pulse is a space (0) and is of the same duration as that of the other bits. A stop pulse is a mark (1) and is a minimum of 1.5 bits in length.

2.2. Code Requirements. The code to be transmitted will meet the following requirements.

2.2.1 Code to be used will be a Field Data Code, consisting of a 6-bit character, plus one odd parity bit.

2.2.2 The 2^0 power, or least significant information bit, is the first bit to be transmitted from each character.

2.2.3 Parity is to be the 2^6 power bit and is the last information bit of each character to be transmitted.

2.3. Message. The message to be generated by the measuring equipment system shall consist of the following:

2.3.1 Digital coordinate values in microns for each axis of the system shall normally consist of six decades (plus sign) per axis.

2.3.2 A start of message character (SOM).

2.3.3 An end of transmission character (EOT). (This bit configuration would normally be a parity error).

2.3.4 A message parity count (MPC). This is the sum of bits of all characters transmitted (including SOM and EOT), and is a non-carry add. Lateral parity is odd. Longitudinal parity is even. The parity bit is to be the sum of the longitudinal parity bits.

2.3.5 Four special instruction characters, each generated by four operator-controlled push on, push off back-lighted switches, two dummy bits (mark or 1), and a parity bit generated by the equipment based upon the condition of the four switches. The fixed dummy bits will occupy the 2^4 and 2^5 bit positions.

2.3.6 A special readout character generated by five momentary-contact push button switches and two fixed dummy bits occupying the 2^5 and 2^6 bit positions. The dummy bits are to be spaces or 0's. It is understood that the parity (2^6) is to be fixed at 0 so that if two of the five switches are pressed at the same time, a parity error will be detected. The five switches are to be understood as readout switches and will also control the request to send, SOM and text as later described.

2.3.7 Three rotary switches are to be provided for machine identification purposes. These switches are to have the capability to create 0 to 9 and are to be placed in the equipment so that only the maintenance engineers will have the capability to change them.

2.3.8 A minimum of 10 twelve-position rotary switches. These switches are to have the capability of producing 0 to 9, minus (-), and space.

2.3.9 The output sequence shall be as described in Appendix A.

2.4. Special Circuits. There is to be no character-by-character acknowledge signal received by the digitizer output circuit. However, there is to be a message acknowledge or error received on the basis of the total message transmitted. The reply will consist of SOM, A or E, EOT, and MPC. In addition, a timer is to be incorporated in the equipment to trigger an alarm if the reply is not received within 3 seconds. The output is to be held in the digitizer buffer until an acknowledge is received or the timer alarm is triggered. If an error signal is received due to a bad transmission, the timer is to be reset and another attempt at transmission is to be made. After a set number of attempts at retransmission (under computer control), an acknowledge or error signal will not be returned and the timer will cycle out. If a readout is initiated but never reaches the computer, the timer will also cycle out, warning the operator that the transmission has not taken place. The return acknowledge or error will not be transmitted until the digitizer transmission is completed.

In addition, an indicator light is to be placed on the control panel in close proximity to the readout switches. On depressing any one of the five readout switches the light is to turn on and remain on for approximately one second or until an acknowledge signal is received, whichever is longer. This will indicate to the operator that a readout has been initiated within the digitizer.

A numerical display of the coordinate system should be placed on the control panel within the operator's field of view. A reset button for each axis shall be placed on the control panel. It is also mandatory that a master reset button be provided, along with a manual set feature for each decade of the counter, to give the operator the ability to set the counter value to a pre-determined value other than zero. A set of two 2-position direction of count switches shall also be included on the control panel.

2.5 Sequence of Operations. Having properly set up the measuring equipment as instructed, the operator will procede to take measurements and thus transmit data. Prior to actuating the readout mechanism, he will set up the necessary computation instructions on the 16 push on,

push off switches comprising the four instruction characters. Then, upon aligning the reference mark with the image, he will depress one of the five readout switches comprising the readout character.

Upon actuating one of the five readout switches, the digitizing system will set the timer, energize the readout indicator light, lock the count in the buffer and visual displays, and send the bit message to the computer. If the computer receives the message and there is no error in it, the computer will send back an acknowledge signal. When the digitizing system receives an error message, it will re-start the timer, energize the readout light, and retransmit the data. The computer has been programmed to repeat the error signal cycle only a set number of times. If after a set number of tries, the computer cannot accept a message, it will not reply to the digitizing system. When the digitizing system receives no reply, the timer completes its cycle, sets off an audible alarm, and releases the buffer storage and visual displays. When an alarm occurs, the operator is to reset the alarm circuits by a push button on the control panel and attempt inputting the message again. If this fails, he is under instructions to call Maintenance.

3. General Physical Requirements.

3.1. Circuit Design. Required performance and critical output timing demand maximum reliability and rapid maintenance. The circuitry must be solid state. Where possible, all circuitry should be on plug-in, printed-circuit cards, with a minimum number of different types used. The design should be to the highest possible commercial standards to insure maximum performance.

3.2. Console Design. The circuitry should all be mounted on standard racks which in turn should be mounted in a single console. The console should be on locking casters and should be of rigid enough construction to withstand constant (at least three or four times daily) moving about within an area. The control panel should be mounted on the console in such a manner that it could be easily viewed and reached by a seated operator.

4. Other Specifications.

4.1. Maximum storage shall be $\pm$999999 for each axis.

4.2. The numerical display shall be an in-line Nixie tube or a 1" projection-type display. Negative numbers are to be displayed as true numbers with a sign (not 9's complement). The visual digital display will be in the metric system with a least count of 1 micron.

4.3. The power requirement for the device shall be 100 - 125 volts, maximum 15 amps, 60 cycle AC.

APPENDIX A

Typical Readout Sequence

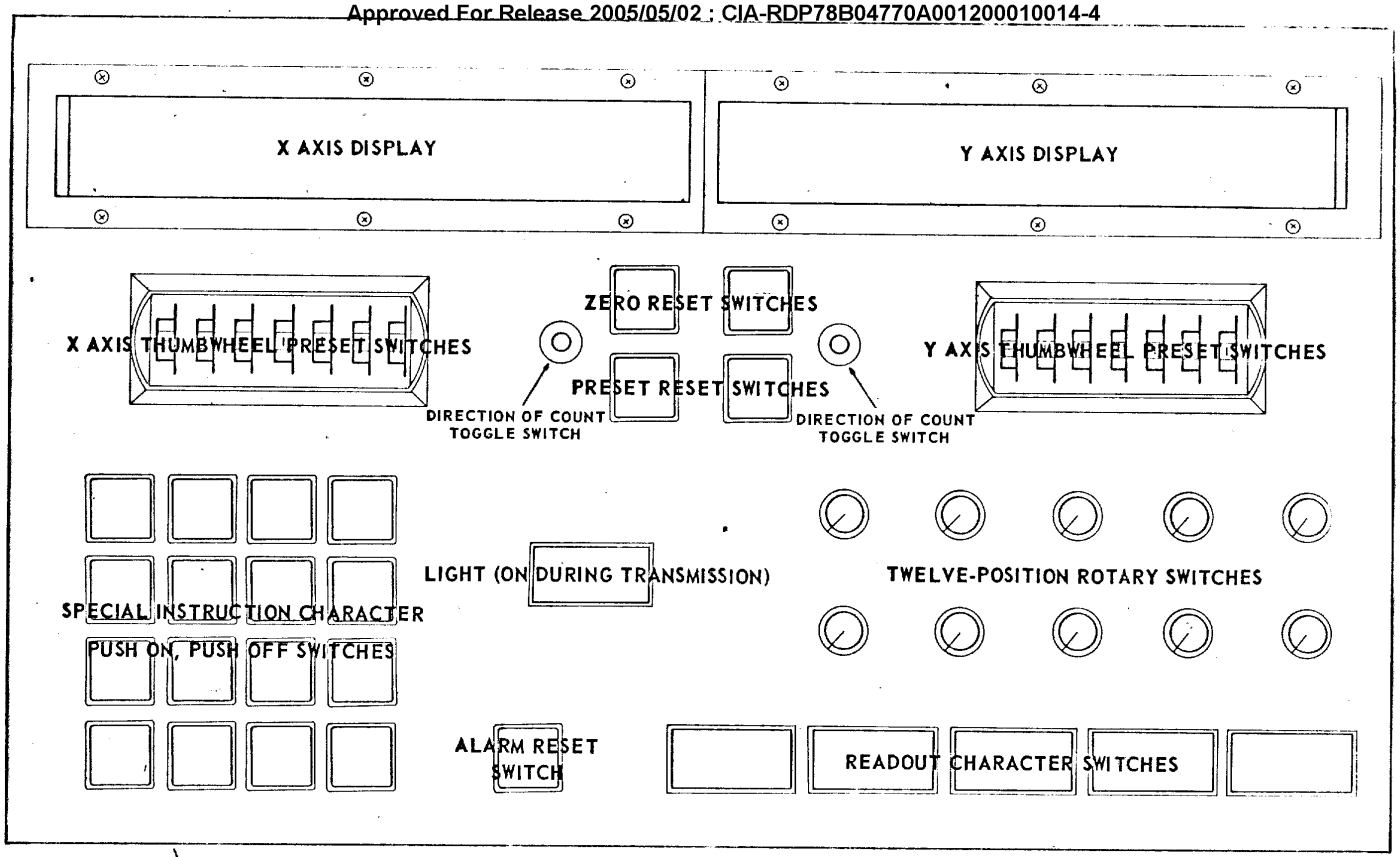
Output Sequence		2^6	2^5	2^4	2^3	2^2	2^1	2^0
1.	SOM	1	0	1	1	0	1	1
2.	Readout Character	0	0	X	X	X	X	X
3.	Instruction Character	P	1	1	X	X	X	X
4.	Instruction Character	P	1	1	X	X	X	X
5.	Instruction Character	P	1	1	X	X	X	X
6.	Instruction Character	P	1	1	X	X	X	X
7.	Sign plus	1	0	0	0	1	0	1
	minus	1	1	0	0	0	0	1
8.	X value 10^5							
9.	X value 10^4							
10.	X value 10^3							
11.	X value 10^2				0 to 9			
12.	X value 10^1							
13.	X value 10^0							
14.	Sign plus	1	0	0	0	1	0	1
	minus	1	1	0	0	0	0	1
15.	Y values 10^5							
16.	Y values 10^4							
17.	Y values 10^3							
18.	Y values 10^2				0 to 9			
19.	Y values 10^1							
20.	Y values 10^0							
21.	(Machine identifiers)							
22.	(Machine identifiers)				0 to 9			
23.	(Machine identifiers)							
24.	12 Position Rotaries							
25.	12 Position Rotaries							
26.	12 Position Rotaries							
27.	12 Position Rotaries							
28.	12 Position Rotaries							
29.	12 Position Rotaries							
30.	12 Position Rotaries				0 to 9			
31.	12 Position Rotaries							
32.	12 Position Rotaries							
33.	12 Position Rotaries							
34.	EOT	1	0	1	0	1	0	1
35.	MPC	See text						

NOTE: The switches are prevented from turning to the twelfth position by mechanical stops.

X = bits controlled by operator switches

P = Parity bit generated by equipment as required on the basis of the condition of the X positions.

	2^6	2^5	2^4	2^3	2^2	2^1	2^0
0 =	1	1	1	0	0	0	0
1 =	0	1	1	0	0	0	1
2 =	0	1	1	0	0	1	0
3 =	1	1	1	0	0	1	1
4 =	0	1	1	0	1	0	0
5 =	1	1	1	0	1	0	1
6 =	1	1	1	0	1	1	0
7 =	0	1	1	0	1	1	1
8 =	0	1	1	1	0	0	0
9 =	1	1	1	1	0	0	1
- =	1	1	0	0	0	0	1
EOT =	1	0	1	0	1	0	1
Error =	1	0	0	1	0	1	0
Acknowledge =	1	0	0	0	1	1	0



CONTROL PANEL
MODEL 2825A

1 0 1 2 3 4 5
1 INCH = 2 INCHES

APPENDIX B

25X1

Specification No. DB-1001
Issue Date: 31 August 1966

CONTRACTUAL DOCUMENTATION TO BE SUPPLIED BY CONTRACTORS

1. SCOPE

1.1 This Specification covers the contractual documentation to be supplied by contractors in the performance of Research and Development contracts.

2. REQUIREMENTS

2.1 General - In order to maintain proper control the progress and funding of Research and Development contracts, it is necessary that certain orderly reporting be accomplished by the Contractor on a regularly scheduled basis.

2.1.1 All documentation submitted by the Contractor shall bear the control number assigned by the Contracting Officer's Technical Representative. This control number shall appear on all correspondence, reports, etc., submitted by the contractor under the contract.

2.2 Types of Reports - The following types of reports shall be submitted by the contractor. Specific reports shall include, but not necessarily be limited to, the designated information.

2.2.1 Monthly - A monthly report shall be prepared as of the last working day of each calendar month. The first monthly report shall be prepared as of the last working day of the first full calendar month subsequent to the date of contract. Monthly reports shall be mailed so as to reach the consignee(s), stated in the contract, not later than the first business day after the fifteenth of the month following the reporting period. Each Monthly report shall provide the following, with negative reporting if applicable.

2.2.1.1 A statement of the activity on the project during the month and the percentage of work completed as of the reporting date.

2.2.1.2 A statement of the planned activity for the next month.

2.2.1.3 A statement of pending, unresolved technical problems.

2.2.1.4 A statement of pending, unresolved contractual problems.

2.2.1.5 A statement for the record, of agreements or understandings reached orally during the reporting period on technical matters not requiring the approval of the Contracting Officer.

2.2.1.6 A statement of any proposed change, agreement or understanding which requires the approval of the Contracting Officer. The contractor is cautioned not to proceed in a situation requiring the prior approval of the Contracting Officer until such approval has been obtained. In situations requiring correspondence with the Contracting Officer, a complimentary copy shall be forwarded, simultaneously, directly to the Contracting Officer's Technical Representative.

2.2.1.7 A statement of unanswered, unresolved matters, unanswered correspondence, etc., and whether delinquency is attributed to the contractor or to the Government.

2.2.1.8 Status of funds. The format shown in Enclosure 1 shall be used to report the status of funds. All applicable items shall be reported. If no expenditures or obligations have been incurred for a specific item, the word "None" shall be entered in the space assigned for the dollar amount.

2.2.2 Final Report - The final report shall be submitted to the Contracting Officer's Technical Representative on or before the thirtieth day following completion of the work under the contract. This report shall cover the entire design and/or development work accomplished during the period of performance and shall contain a section covering the work performed under each of the tasks set forth in the Work Statements. The report shall state concisely but completely the major problems encountered, the apparent cause of the problems, the problem solutions and an evaluation of the solutions based on actual application of the solutions.

2.2.3 Installation Engineering Data - Whenever hardware is a deliverable item under a contract the contractor shall provide the Installation Engineering Data requested on Enclosure 2. The Contracting Officer's Technical Representative shall provide the blank forms to the Contractor. Preliminary data shall be submitted to the Contracting Officer's Technical Representative at six months and again at three months prior to the delivery date of the equipment. Final data shall be submitted by the contractor not less than thirty days prior to the delivery of the equipment.

2.2.3.1 The outline drawing, submitted with the Installation Engineering Data form shall show:

(a) the orientation of the equipment within the work area for normal equipment useage.

(b) the exact location of all external connections.

(c) the clearance required around the equipment for access to all removeable panels, doors, etc.

(d) the location of mounting points and type of mounting required.

2.3. Delivery of Reports - All monthly reports and the final report shall be forwarded by the contractor to the Consignee(s) specified in the contract. The contractor shall forward each report in the number of copies specified in the contract.

2.3.1 The Installation Engineering Data form plus the outline drawing shall be forwarded to the Contracting Officer's Technical Representative.

Statement of Funds as of 30 September 19XX (See Note 1)

EXPENDITURES

1.	Labor:		
	a. Total paid as of 31 August 19XX	XX,XXX	
	b. Paid during September 19XX	X,XXX	
	c. Sub-total		XX,XXX
2.	Material:		
	a. Total paid as of 31 August 19XX	X,XXX	
	b. Paid during September 19XX	XXX	
	c. Sub-total		X,XXX
3.	Services (sub-contracts, etc.):		
	a. Total paid as of 31 August 19XX	X,XXX	
	b. Paid during September 19XX	XXX	
	c. Sub-total		X,XXX
4.	Total expenditures as of 30 September 19XX		XX,XXX

OBLIGATIONS AND ESTIMATES

5.	Obligations:		
	a. Sub-contract W/ABC Co., amount not yet paid	X,XXX	
	b. Sub-contract W/DEF Co., amount not yet paid	XXX	
	c. Material ordered but not yet paid for	XXX	
	Sub-total		X,XXX
6.	Estimates of Future Expenditures:		
	a. Estimate of labor required	X,XXX	
	b. Estimate of material required	XXX	
	c. Proposed sub-contracts	XXX	
	Sub-total		X,XXX
	Total		XX,XXX

Enclosure 1

NOTES:

1. All amounts shown above must include overhead, G&A, handling charges, fees, etc.

INSTALLATION ENGINEERING DATA

Date form completed _____

(See Remarks at end of form)

Tentative [ ] Valid until _____

Final data [ ]

I. INSTRUMENT
- A. Name of instrument: _____
- B. Manufacturer: _____
- C. Contract number: _____
- D. Delivery date: Tentative: _____ Final: _____

II. PHYSICAL FEATURES
- A. Sub-assemblies:
  1. Number of sub-assemblies: _____
  2. Largest sub-assembly: Weight _____lbs; _____" H x _____" W x _____" D
  3. Heaviest sub-assembly: Weight _____lbs; _____" H x _____" W x _____" D
- B. Assembled instrument:
  1. Number of major components: _____
  2. Largest component: Weight _____lbs; _____" H x _____" W x _____" D
  3. Heaviest component: Weight _____lbs; _____" H x _____" W x _____" D
  4. Total floor space required after assembly, including maintenance access space. ___Ft. ___In. High x ___Ft. ___In. Wide x ___Ft. ___In. Deep.
  5. Total weight of assembled instrument: _____lbs.
- C. Type of base of mount: Flat ____; 3-point suspension ____; 4-point suspension ___
- D. Does the instrument have built-in mobility? Yes ____ No ____
- E. Is the instrument particularly sensitive to vibration? Yes ____ No ____
  Will the instrument generate vibration? Yes ____ No ____
- F. Are any special or unusual tools or fixtures necessary or adviseable for the installation of the maintenance of this instrument? Yes ____ No ____.
  If "Yes," please describe: _____

III. UTILITIES
- A. Electrical:

	AC	DC
1. Voltage	_____Volts / _____Volts	_____Volts / _____
2. Current	_____Amps/phase	_____Amps
3. Frequency	_____cps	
4. Nr. of phases	_____Ph	
5. Nr. of wires	_____	
6. Power required	_____Watts	_____Watts
7. Power factor	_____(Leading) (Lagging)	

  8. Type of outlet: Two prong ___; three prong ___; Twist lock ___; Perm.___
  9. Type of ground: Building conduit ___; Direct earth ground ____.
  10. Should the instrument be shielded, either from external electromagnetic signals or to prevent interference with other equipment? Yes ____No____
  If "Yes," to what extent? _____

B. Air conditioning:

1. Desired environment: Room air temperature of ___ °F ± ___ °F and relative humidity of ___% ± ___%.
2. Input Air: Is a direct connection necessary? Yes ___ No ___; Adviseable? Yes ___ No ___; If "Yes," what is the connector type and size? _____ Recommended input air temperture ___ °F ± ___ °F. Relative humidity ___% ± ___%. If input air must be filtered, what is the maximum particle size in microns? ___ What particle count? _____/ cu. ft.
3. Output Air: Is a direct connection to the return air duct necessary? Yes ___ No ___. Adviseable? Yes ___ No ___. Connector type and size? _____. Output air temperature ___ °F ± ___ °F. Relative humidity ___% ± ___%. Output heat ___BTU/Hr. Flow of ___CFM. Is output air toxic? Yes ___ No ___; Noxious? Yes ___ No ___.

C. Plumbing:

1. Is water required? Yes ___ No ___; Pressure ___PSIG, flow ___GPM.
2. Type of water required:
   Tap ___ °F ± ___ °F Deionized ___ °F ± ___ °F
   Tempered ___ °F ± ___ °F Filtered ___ °F ± ___ °F
   If filtered, give maximum permissible particle size in microns and the maximum permissible count. _____ microns _____ particles/cu. ft.
3. Pipe required:
   Galvanized ___ Copper ___ Size _____
   Stainless Steel ___ Plastic ___ Type of connector _____
4. Floor drain:
   Diameter of drain ___ Galvanized drain? ___
   Plastic drain? ___ Glass drain? ___
5. Are any chemical solutions used in the device? Yes ___ No ___. If "Yes," state the nature of the solution(s), permissible temperature range, flow rate in appropriate units and the filtration necessary for each solution _____.
6. Size of pipes and connectors _____.

D. Compressed air:
Is compressed air required? Yes ___ No ___. Water free? ___ Oil Free? ___
Type and size of connector? _____. Pressure _____PSIG. Flow in CFM
Maximum ___, minimum ___, average ___.

E. Vacuum:
Is vacuum required? Yes ___ No ___. Pressure ___PSIA or (inches of water) (millimeters of mercure). Displacement in CFM, maximum _____, minimum _____, average _____. Type and Size of connectors _____.

F. Peripheral Devices:
Will the instrument be connected to any peripheral devices such as a computer or data input or data output device? Yes ___ No ___. If "Yes," give, in detail, the nature of the connection to the peripheral device such as coaxial cable, multiple wire connector, etc.

IV. REMARKS

A. Use additional sheets if more space is required for environmental conditions or utilities not mentioned above.
B. Submit three typed copies of the completed form to the Technical Representative.

C. Attach three copies of a dimensioned outline drawing of each major component and of the completed assembly. Include the estimated weight of each major component and of the completed assembly. Indicate, on the outline drawing of the completed assembly, the space required for access to the instrument for maintenance.

D. If a question does not apply to the instrument, insert "N/A" (Not Applicable) in the appropriate blank space.

Information provided by:

_____
(Signature)

_____
(Position or job title)